

# The Mobile Army Surgical Hospital (MASH): A Military and Surgical Legacy

Maj. Booker King, MD, FACS, and Col. Ismail Jatoi, MD, PhD FACS  
*Heidelberg, Germany and Bethesda, Maryland*

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Operation Iraqi Freedom was perhaps the last military campaign that will ever utilize the services of a mobile Army surgical hospital (MASH). The Army has now essentially replaced the MASH with combat surgical hospitals (CSH) and forward surgical teams (FST). MASH units were designed as mobile, flexible, forward-deployed military hospitals, providing care for the wounded near the frontlines of the battlefield. These hospitals not only saved thousands of lives during war but also greatly influenced the delivery of trauma and critical care in civilian hospitals. The MASH was made popular by the television series of the 1970s, depicting the 4077th during the Korean War. Although a comical series, these television episodes provided viewers with a glimpse of life in a MASH during time of war. This article chronicles the history of the MASH from its inception during World War II to recent experiences in Operation Iraqi Freedom.

**Key words:** mobile Army surgical hospital ■ forward surgical teams ■ combat support hospitals ■ mobile hospitals ■ military medicine ■ Army medicine ■ field hospitals ■ war surgery

## INTRODUCTION

Mobile Army surgical hospitals (MASH) were designed to keep pace with combat units during time of war, providing immediate, lifesaving care to casualties. MASH units have been deployed in every major U.S. military conflict since World War II and are undoubtedly responsible for saving thousands of lives on the battlefield. Interwoven with this history of the MASH is the history of resuscitation and care of combat casualties. The authors of this article recently served with the 212th MASH during Operation Iraqi Freedom. The 212th entered Iraq on the first day of the war and cared for a large number of both military and civilian casualties during the initial weeks of this military campaign. In this article, we chronicle the history of the MASH and outline its many contributions to military and civilian trauma care.

## World War II: Birth of a Concept

Many concepts implored in modern military surgery can be traced to the innovations of Baron Dominique Jean Larrey during the Napoleonic Wars.<sup>1</sup> Larrey, hailed by many as the father of combat medicine, laid the foundation for medical evacuation as we know it today with his "ambulance volante." He was also one of the first military physicians to conceptualize forward surgical hospitals by bringing medical support to the frontline. These concepts translated later to the mobile units of World War II and the Korean War.

During the later part of World War II, it became apparent that the transport of patients to field hospitals and general hospitals in the rear was time-consuming and cost many lives.<sup>2</sup> The notion of providing immediate lifesaving treatment to soldiers on the battlefield was therefore introduced. This meant that special surgical teams needed to be deployed closer to the frontlines. The field hospital was the Army's most mobile medical unit at the beginning of World War II.<sup>3</sup> These hospitals were comprised of three or four smaller units, with a combined 400-bed capacity. These medical units were generally situated near airfields, to facilitate

© 2005. From the Department of Surgery, U.S. Army Hospital Heidelberg (King, Major, U.S. Army Medical Corps), Heidelberg, Germany and the Department of Surgery, Uniformed Services University of the Health Sciences, Bethesda, MD (Jatoi, Colonel, U.S. Army Medical Corps). Send correspondence and reprint requests for *J Natl Med Assoc.* 2005;97:648-656 to: Booker King, Department of Surgery, U.S. Army Hospital Heidelberg, APO AE 09042; phone: 011-49-6221-172631; fax: 001-49-6221-173343; e-mail: Booker.King@us.army.mil

transport of injured patients out of the combat zone. Field hospitals were large, fixed facilities, unable to advance with rapidly moving combat troops, and evacuation to these hospitals required the use of ground ambulance. The time required for evacuation was often lengthy, and many of the most severely injured patients did not survive transport.

In the early 1940s, Colonel Michael DeBakey (one of the founders of modern cardiac surgery) and other members of the surgical consultants division were given the task of providing the surgeon general with recommendations on the optimal delivery of surgical care

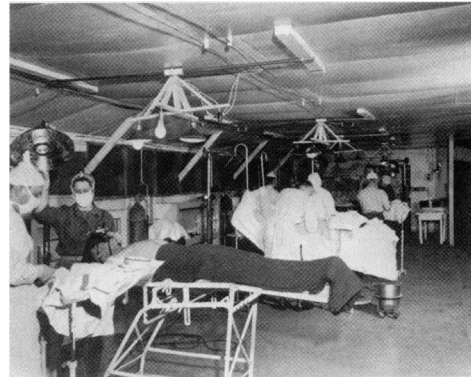
to soldiers on the battlefield (Figure 1).<sup>4,5</sup> The surgical consultants division recommended the creation of “auxiliary surgery groups” (ASGs). These were to be small, mobile units attached to larger field and evacuation hospitals. Brigadier General Fred W. Rankin (head of the surgical consultants division) and General Norman T. Kirk (surgeon general of the Army) immediately endorsed these recommendations. Initially, there was difficulty in convincing some members of the Army staff to adopt this concept. However, the eventual effectiveness of these mobile units in combat soon alleviated any skepticism.

ASGs were effective despite the relative inexperience of their surgeons. Many of these surgeons had less than three years of surgical training. However, these groups were successful in providing resuscitation, surgical management and postoperative care in

**Figure 1.** Colonel (Dr.) Michael DeBakey receiving the Legion of Merit Award from General Rankin for his contributions to the development of the MASH (photograph courtesy Dr. Michael DeBakey).



**Figure 2.** Surgery performed at 1st MASH in Korea (from AMEDD history website with permission).<sup>28</sup>



**Table 1. Battle Deaths, Wounded in Action, Died of Wounds and Postevacuation Mortality for U.S. Army in Major Conflicts**

	(World War I—Operation Iraqi Freedom)			
	Battle Deaths (Army)	Wounded in Action (Army)	Died of Wounds (Army)	Postevacuation Mortality (All services)
World War I	50,510 (1.2%)	193,663 (4.8%)	NA	8.5%
World War II	234,874 (2.0%)	565,861 (5%)	20,810 (3.7%)	4.0%
Korean War	27,709 (0.98%)	77,596 (2.7%)	1,887 (2.4%)	2.5%
Vietnam War	30,922 (0.7%)	96,802 (2.2%)	3,598 (3.7%)	2.6%+
Gulf War	98 (0.036%)	354 (0.13%)	2 (0.6%)	NA
Iraqi Freedom	552 (0.56%)*	5,270 (5.4%)*	101 (2.0%)*	NA

NA: Not Available; \* Data from March 19, 2003 – September 25, 2004; + Slight increase in mortality thought to be attributable to increased evacuation of critically injured patients; Data prepared from: Washington Headquarters Services, Directorate for Information, Operation and Reports

the battle zone.<sup>24</sup> Each ASG consisted of a chief surgeon, an assistant surgeon, an anesthesiologist, a surgical nurse and two enlisted technicians. Specialized teams were also formed, with surgeons selected from various disciplines, including thoracic surgery, neurosurgery, plastic surgery, maxillofacial surgery and orthopedics. Four such ASGs were initially organized during World War II, and a fifth group was added later.

The Second Auxiliary Surgical Group, under the command of Colonel James C. Forsee, was the first mobile surgical hospital activated during World War II. This unit supported the Fifth Army (160,000 troops) in North Africa, Sicily and Italy in 1943. The ASGs were able to maneuver with combat units and sustained operations within a few miles of the frontlines. This led to shorter evacuation times, earlier resuscitation of the wounded and reduction in casualty deaths. At the time of the Allied invasion of Normandy, ASGs were called to support the First, Third, Seventh and Ninth Armies. Shortly before the beginning of the Korean War, the ASGs were

renamed "Mobile Auxiliary Surgical Hospitals" and later "Mobile Army Surgical Hospitals."

## The Korean War: The War that Defined the MASH

On Sunday, June 25, 1950 the North Korean People's Army crossed the 38th parallel into South Korea. This led to the Korean War, which lasted nearly three years.<sup>6</sup> One of the defining aspects of the Korean War was the use of the MASH. Ten MASH units supported four Army divisions (15,000 to 20,000 soldiers per division) at positions throughout North and South Korea. During the Korean War, the experiences of these MASH units translated to improvements in resuscitation and trauma care, patient transport, blood storage and distribution, patient triage, and evacuation.<sup>7</sup>

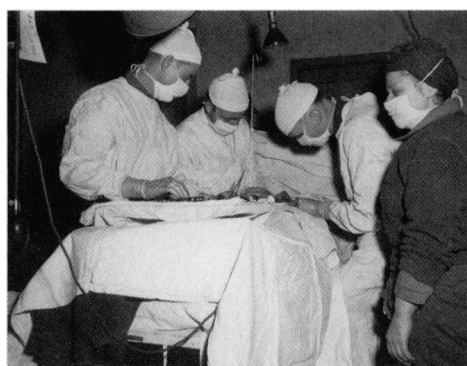
At the beginning of the Korean War, very few U.S. military medical units had any experience in northeast Asia. Colonel Chauncey Dovell, Eighth U.S. Army surgeon, quickly dispatched MASH units to Korea to provide medical support.<sup>8</sup> MASH units were able to rapidly deploy and quickly adapted to the rugged Korean terrain. The 8063rd MASH, supporting the famed 1st Cavalry division, was the first medical unit to enter Korea. The 8076th MASH soon followed and landed in Pusan. MASH units underwent rapid transformations from the Army's original "Table of Distribution and Allowances" to support the large influx of patients. To meet new challenges, inpatient bed capacity rose from 60 to more than 200 beds, with more vehicles, tentage and equipment added to each unit.

Major advances in patient transport and evacuation occurred during the Korean War. Aeromedical evacuation was initially the responsibility of the Air Force, which utilized large aircraft to transport patients to hospitals in the rear.<sup>9</sup> During the Korean War, helicopters, referred to as "air ambulances" were introduced, and these aircraft evacuated wounded soldiers from battlefield positions to MASH units near the frontline. In 1951, the 8063rd MASH was the first unit to use helicopters to evacuate casualties. The Bell H-13 was the primary helicopter used for "Medevac" (medical evacuation). Two patients were transported on skids placed outside each helicopter, limiting the treatment each patient received during transport. In 1952, Army Medevac units were organized and assigned to the Eighth Army medical command. In 1953, Medical Service Corps officers became the primary pilots for medevac flights. These officers were chosen for their expertise in transporting the wounded. Air evacuation undoubtedly contributed to the dramatic reduction in the death rate of wounded soldiers in the Korean War, compared with previous conflicts

**Figure 3.** Receiving ward at MASH in Korea (from AMEDD history website with permission).<sup>28</sup>



**Figure 4.** Operating room of the 44th MASH in Korea in 1954 (from AMEDD history website with permission).<sup>28</sup>





(World War I, 8.5%; World War II, 4%; and Korean War, 2.5%) (Table 1).

Although the concept of field triage was not initiated during the Korean War, it certainly underwent substantial modifications during this conflict.<sup>10</sup> Triage was initiated at battalion aide stations (each supporting up to 1,000 soldiers per battalion), which were small medical units with limited capabilities. At these stations, nurses and general medical officers were responsible for deciding whether to evacuate wounded soldiers or return them to duty (after minor therapy). Soldiers that were evacuated to MASH units were triaged further, depending on the extent of their injuries and hemodynamic status.

Many deaths occurred at battalion aide stations. Consequently, more experienced personnel were assigned to battalion aide stations and equipped to perform simple lifesaving interventions, such as placement of tourniquets and insertion of chest tubes. Patients needing surgery and all critical patients were rapidly evacuated to the MASH by helicopter. At the MASH, triage medical officers, nurses and surgeons evaluated each injured patient, and the most critical were prioritized for surgery. Due to the large influx of casualties at most MASH hospitals, some patients with massive injuries who were considered unlikely to survive were often managed expectantly. Patients requiring specialized medical or surgical therapy, such as neurosurgery, plastic surgery or dialysis, were evacuated to specialty centers. Triage at the MASH units was modeled after the dictum: "life takes precedence over limb, function over anatomical defects."

There were numerous improvements in perioperative care and anesthesia during the Korean conflict, based on experiences at the various MASH units.<sup>11-13</sup> The resuscitation of casualties with crystalloid was not practiced until the Vietnam War, therefore, as in World War II unstable patients were often transfused whole blood. This was effective for resuscitation in some patients; however, acute renal failure was seen in 0.5% of casualties evacuated from the battlefield. Acute renal failure in this setting yielded high mortality despite supportive care (80–90%). Anesthesiologists adopted the practice of using small amounts of narcotic for induction. Chloroform and ether were abandoned as anesthetics because of their negative inotropic effects, and nitrous oxide became the gaseous anesthetic most widely used. Thiopental was used for induction but applied cautiously to prevent the respiratory depression that occurred at moderate dosages. Tubocurarine and succinylcholine were widely used to enable rapid intubation.

MASH surgeons performed numerous retrospective studies that soon greatly influenced trauma care around the world.<sup>14,15</sup> Experience from the Korean War showed that intravenous vasoconstrictors were

inferior to blood in perioperative resuscitation. The importance of artificially warming the injured patient was also rediscovered (a practice first described by Walter Cannon in World War I). At the start of the Korean War, blood and other fluids were infused through glass bottles without filters, and some cases of air embolism were reported. As a result of these reports, filters were added to the infusion bottles.

The importance of adequate debridement of devitalized tissue also became evident during the Korean War.<sup>7</sup> A significant number of soldiers presented with open wounds of the extremities and trunk. As a result of the experiences during World War II, definitive care of open wounds was never done at the MASH during the Korean War. Following initial debridement and irrigation of open wounds at the MASH, local wound care continued until definitive surgery was

**Figure 5.** Aerial view of the 212th MASH in Iraq (80 miles south of Baghdad).



**Figure 6.** 212th MASH personnel resuscitating a casualty in the triage area.





eventually performed at hospitals in the rear. Penicillin was administered and continued postoperatively for several days. The use of tetanus toxoid was initiated and routinely administered to all patients with penetrating injuries. Surgeons came to realize that antibiotics could not adequately treat wounds unless thorough debridement had been performed.

Several advances in vascular surgery occurred during the Korean War. Paramount among these was improvement in surgical techniques of vascular injury repair.<sup>16,17</sup> Ligation of injured vessels was standard in World War II, with few repairs attempted. Vascular repair during the Korean War, however, led to a significantly lower amputation rate when compared with World War II (13% vs. 36%). Autologous vein and arterial homografts were commonly used for arterial reconstruction. Improvements in medical evacuation allowed for arterial injuries to be treated an average of 9–14 hours after wounding, thereby leading to better rates of limb salvage.

The logistical difficulties in the storage and allocation of blood led to the development of a blood program during the Korean War.<sup>18</sup> In the early days of the war, blood was collected and delivered by the 406th Medical General Laboratory in Tokyo. The mission of the 406th Medical General Laboratory was to control the distribution of type-specific blood to hospitals in Japan and mobile hospitals throughout the theater of operations. Concomitantly, type-O blood was shipped directly from the continental

United States. Blood was delivered to Korea by air. Shipments were then taken to medical supply depots, where blood was stored and distributed to hospitals in the combat zone. At the MASH, most of the blood was transfused just prior to evacuation of the injured. Battalion aide stations and other lower-level medical units had little blood in supply. Due to the large influx of patients and limited ability to resuscitate casualties, the medical units below the level of the MASH rarely transfused patients.

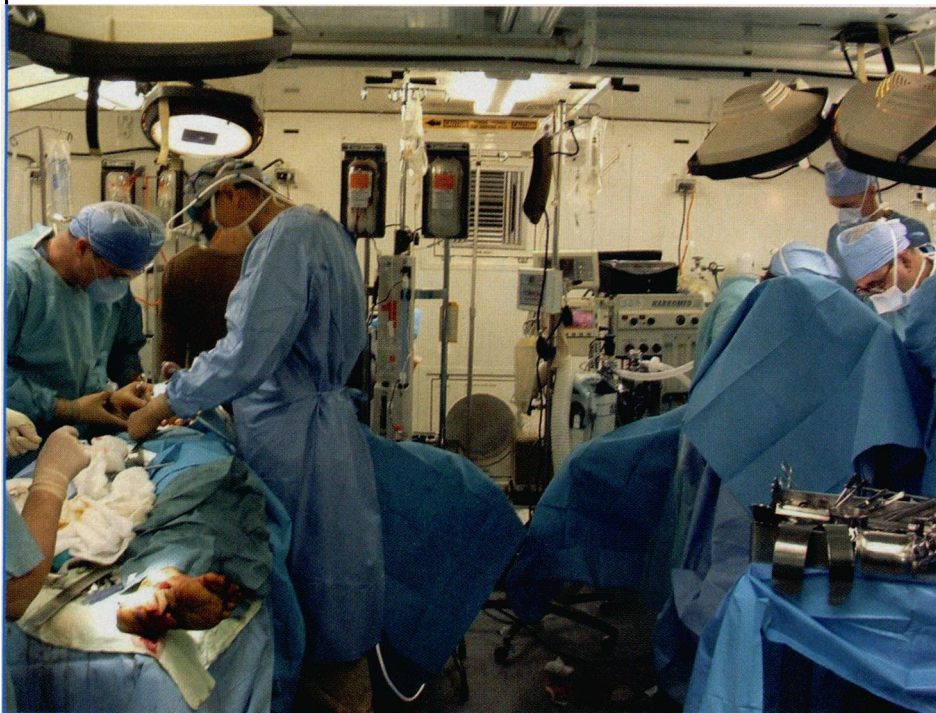
The 4077th MASH television series that was widely viewed during the 1970s was based on Richard Hooker's experience as a surgeon during the Korean War. The living conditions shown in this series seemed harsh. However, the conditions in the actual MASH were far worse.<sup>7,19</sup> MASH personnel had to endure extremes of temperature and rugged mountainous terrain. Their convoys traveled through treacherous battlegrounds, and the hospitals were assembled only a few miles from the frontline. MASH units often moved several times each month to keep pace with combat units. Medical personnel worked long hours to care for the large influx of casualties, and surgeons operated continuously with little relief. In some MASH units, monthly admission rates of over 3,000 casualties were not uncommon. Compounding all these hardships was the vulnerability of the MASH units to enemy attacks and short-range artillery.

The MASH personnel endured rigorous living conditions and large casualty loads for much of 1950 and 1951. During this period, 200-bed MASH units often treated over 400 patients a day. By the later part of 1953, it became evident that the war was ending, and six MASH units were left in Korea (five of which were active). These remaining units were given the responsibility to treat prisoners of war and civilian casualties.

### Vietnam War: MUST vs. MASH

The Vietnam War was radically different from either the Korean War or World War II. Guerilla tactics employed by the Vietcong required drastic changes in combat philosophy, with resulting changes

**Figure 7.** Surgeons operating in the portable operating container of the 212th MASH in Iraq.



in combat medical support.<sup>20</sup> During this conflict, the “battlefront” was not readily evident. Therefore, some military planners did not regard mobile hospitals as essential. Thus, some U.S. military hospitals in Vietnam were established as semi-permanent, fully equipped facilities.

The Medical Unit Self-Contained Transportable (MUST) units were introduced in Vietnam.<sup>21</sup> These were expandable, mobile shelters with inflatable ward sections. Expandable sections were also provided for the radiology, laboratory, pharmacy, dental and kitchen areas. Most notable among the MUST units was the 45th Surgical Hospital in Tay Ninh, Vietnam. In November 1966, following construction of a semipermanent facility, mortars struck the hospital. The hospital commander, Major Gary P. Wratten, was killed. The hospital then set up a new position in northeast Tay Ninh. It was subsequently again struck by mortar, without sustaining serious casualties. The 45th Surgical Hospital performed exceptionally well despite these incidents, and the MUST equipment was provided to several more surgical hospitals that deployed to Vietnam. MUST units remained semipermanent, relatively stationary facilities during the early years of the war. However, in 1968, the U.S. Pacific command surgeon ordered that all MUST units become mobile. Thus, the MUST units then assumed the role traditionally relegated to the MASH. For the remainder of the war, MUST units were ordered to maintain their equipment and training to ensure mobility.

One of the few MASH units deployed to Vietnam was the 2nd MASH.<sup>22</sup> The 2nd MASH was active in south Vietnam from October 1966 to July 1967. During this nine month period, 1,011 surgical cases were performed at this 60-bed unit. The experience of the 2nd MASH has been extensively chronicled. At the 2nd MASH, the management of high-velocity wounds, vascular trauma, colorectal injuries and burn injuries were vastly different from that of the Korean War era, reflecting innovations in the delivery of surgical care that had occurred during the preceding decade. Additionally, improvements in aeromedical evacuation contributed significantly to a decrease in mortality.

In Vietnam, surgeons in the MUST and MASH units contributed to several major innovations in combat casualty management, particularly in wound and burn care.<sup>23</sup> Early debridement of high-velocity missile wounds and delayed primary closure were universally practiced among military surgeons in Vietnam. Further improvements in vascular surgery during the Vietnam War resulted in an average amputation rate of 8%. Once again, this reduction in amputations was due to improvements in surgical technique but more directly related to an average evacuation time of two hours.<sup>24,25</sup> Exploratory laparotomies were performed more frequently, particularly

in cases of blunt trauma or blast injuries, where internal abdominal injuries were less obvious.

There were novel improvements in the care of the burned patient.<sup>26</sup> Military surgeons developed sulfamylon and came to realize that fluid resuscitation was vitally important in the treatment of burns. This resulted in a 50% reduction in mortality for burn patients in the Vietnam War, compared to the Korean War. The importance of aggressive debridement of phosphorous burns was also emphasized, improving survival of patients exposed to this agent.

Equally important were improvements in anesthesia and critical care. Surgeons in the Vietnam conflict began to realize the importance of perioperative fluid resuscitation.<sup>27-30</sup> Blood, plasma, low molecular weight dextran and crystalloid were all used for resuscitation. The benefit of resuscitation with balanced salt solutions as well as whole blood was demonstrated by studies conducted at the Naval Support Activity in Da Nang. These studies clearly showed that balanced salt solutions replete the extracellular compartment and are therefore an essential component to the resuscitation of patients in hemorrhagic shock. Plastic bags replaced glass bottles and became a more efficient means of transporting blood and crystalloid. Central venous catheters were placed in some casualties to guide fluid therapy. Central venous pressure was measured by a standard manometer, and arterial catheters were often placed to obtain serial arterial blood gases. Anesthesiologists began using halothane, which had fewer negative inotropic effects. Newer techniques in the management of ventilated patients led to earlier extubation in the rear hospitals.

“Da Nang Lung” or acute respiratory distress syndrome (ARDS) was seen in casualties with severe hemodynamic compromise who often required massive blood transfusions.<sup>31,32</sup> ARDS was not seen in earlier conflicts, since soldiers who were severely compromised often did not survive transport to even forwardly mobile medical units. Surgeons initially used diuretics and fluid restriction to treat ARDS with little success. Clinical suspicion became the best diagnostic tool as ARDS is often advanced once detected on chest radiograph. The hypoxia seen in these patients was refractory to standard oxygen therapy. The work of Colonel Robert Hardaway and Dr. David G. Ashbaugh showed the value of continuous positive airway pressure in the maintenance of adequate arterial oxygenation in patients with ARDS.

The guerilla warfare in Vietnam led to additional improvements in aeromedical evacuation. Air ambulances were responsible for saving thousands of lives in the battlefield. The UH-1D (Huey) transported six-to-nine patients at one time.<sup>33</sup> Most patients were evacuated within 30–35 minutes following injury,

with few evacuations occurring after more than two hours. Flight medics were skilled and competent at transporting severely injured casualties. "Dust-off" was the call sign used to summon these courageous aviators. As a result of efficient and expeditious evacuation, overall hospital mortality was 2.6% during the Vietnam War. Ironically, this was slightly higher than that seen during the Korean War (2.5%). This paradox can best be explained by the fact that improvements in aeromedical transport allowed evacuation of more very severely injured patients to nearby hospitals. Many of these patients would not have survived the longer evacuation time required during the Korean War.

During the early years of the Vietnam War, the Air Force used cargo planes to evacuate patients to hospitals in the rear. By 1968, casualty evacuation had increased to almost 6,000 patients per month. The Air Force then dedicated several C-118 airplanes for aeromedical evacuation. These aircraft were supplemented with special medical equipment and medical personnel.

One of the hallmarks of the Vietnam War was the development of an organized military blood program.<sup>34</sup> The distribution of blood was initially regulated at the 406th Medical Laboratory in Japan. Mobile teams were created to procure and distribute blood to hospitals in Vietnam. However, type-specific blood was distributed to hospitals in Japan, while universal donor O-negative blood was transported directly to Vietnam. Physicians recognized and treated coagulopathies resulting from massive hemorrhage and disseminated intravascular coagulation. Various strategies were adopted to treat coagulopathy, including the administration of fresh blood, fresh frozen plasma, cortisone, heparin and epsilon aminocaproic acid. Advancements—including the use of adenine to preserve cells, new methods of refrigeration and styrofoam blood containers—also occurred in the storage of blood. These advancements resulted in an average increase in shelf life of whole blood and blood products from 21-to-40 days.

## The Gulf War

Operation Desert Storm was the first major conflict involving U.S. forces since Vietnam.<sup>35,36</sup> Over 500,000 U.S. troops were deployed, with thousands of additional coalition forces. It was clear from the onset that this war would be fought with a radically different strategy. The exceedingly rapid mobilization of troops and equipment ushered in a new era of military medical care. Medical units had to become smaller, more flexible and more mobile.

Operation Desert Storm was initiated with a prolonged air campaign that lasted 38 days (January 17 to February 24, 1991). However, the ground war that fol-

lowed lasted only 100 hours, with 148 U.S. troops killed and 458 injured. Medical assets were mobilized to support a rapidly advancing army. The larger, less mobile, combat support hospitals (CSHs) were deployed along with the highly mobile MASH. The CSH units contained 3–4 operating tables and up to 200 intensive care and ward beds. These units utilized deployable medical systems (DEPMEDS) or tent expandable modular personnel (TEMPER), which were durable and easily erected in any environment. The CSH units were large and relatively nonmobile, and only portions of these units deployed to forward areas of the battlefield. The smaller elements of the CSH were known as forward surgical elements (FSE) or forward surgical teams (FST) and consisted of a triage/patient receiving area, 1–2 operating tables and 6–8 postoperative and intensive care beds.

Similarly, the 5th MASH was broken up into smaller units to improve flexibility and mobility.<sup>37</sup> Four surgical units were created from this break-up: the FST, FSE, MASH (-) and the main body of the MASH. The FST was designed to advance ahead of the main MASH unit and capable to receive patients within two hours of arriving at its destination. The FST had limited supplies and could function independently only for 24–36 hours. The FSE, like the FST, could be assembled in two hours. It consisted of 110 personnel and four operating tables. FSEs were intended to sustain operation for much longer than the FST. The MASH (-) was a 36-bed hospital with 3–4 operating room tables, intended as a more rapidly deployable version of the MASH. The main body of the MASH had six operating room tables and 60 ward and intensive-care beds with separate sections for radiology, pharmacy, laboratory, central material supply and patient administration. It should be noted that the various smaller units of the MASH treated a large number of both military and civilian casualties throughout the war with considerable success.

The 5th MASH FSE was the first portion of the MASH to deploy into Iraq, and sustained operations for 48 hours. The FSE then joined the MASH (-) and advanced even further. Of note, the MASH (-) cared for the injured for seven days inside enemy territory. The FST was the final element to deploy and move deeper into Iraq and remained operational for one week, supported by surrounding medical units.

A large controversy arose in the Army medical department after the Gulf War.<sup>38</sup> Many questioned the ability for MASH units to rapidly deploy and keep pace with highly mobile light infantry divisions. Many MASH units were decommissioned to allow the development of more mobile FSTs, which would go on to play an integral role in the war against terrorism in Afghanistan and have a prominent role in this recent conflict in Iraq.

## The Balkans: Peacekeeping Missions

The signing of the Dayton Peace Accord ended years of ethnic strife in the former Yugoslavia. The North Atlantic Treaty Organization (NATO) dispatched troops for a peacekeeping mission in December 1995.<sup>39</sup> Approximately 30,000 U.S. soldiers were deployed. Units from several nations provided medical support. In this conflict, there were very few U.S. military casualties, and the deployed medical units primarily treated injured civilians.

The 212th MASH (now the last MASH in the Army) was deployed to provide medical support as part of the "initial stabilization force" (IFOR). The 212th MASH operated a 30-bed facility that provided lifesaving care to soldiers injured in combat. However, much of the efforts of the MASH were directed towards providing humanitarian assistance to the local civilian population. In recent years, the 212th MASH has provided humanitarian assistance in Bosnia-Herzegovina, Croatia, Kosovo and Macedonia.

## Operation Iraqi Freedom

The 212th MASH played a prominent role in the recent conflict in Iraq. The 212th is a 36-bed hospital with six emergency room beds and two operating room tables.<sup>40</sup> The personnel assigned to the MASH were trained to set up the entire hospital in 12 hours (Figures 5–7). However, this proved to be a laborious undertaking, requiring considerable manpower.

During Operation Iraqi Freedom, the clinical staff of the 212th MASH consisted of two general surgeons, a thoracic surgeon, plastic surgeon, orthopedic surgeon, gynecologist, anesthesiologist, emergency medicine physician, internist, family practitioner and nursing staff from various disciplines. The 212th MASH was the first U.S. military hospital to enter Iraq during the war (on March 21, 2003) and provided medical care to the advancing 3rd Infantry Division. Not since the Korean War was a MASH unit able to demonstrate this sort of mobility. There were 100 operations performed during 19 days of active combat (March 27 to April 14, 2003). A high proportion of injuries treated at the MASH involved the extremities. Wounds were generally debrided and kept open, and eventually closed at hospitals in the rear. There were few head and torso injuries among U.S. troops, attributable to the body armor worn in combat.

Battle casualties were evaluated, and initial resuscitation was performed in the triage area in front of the MASH. The triage area was located in close proximity to the helicopter-landing zone to facilitate patient transport into the MASH. Patients with minor injuries were treated and returned to duty. Those patients requiring surgery were admitted for preoperative preparation or taken directly to the

operating room if emergency surgical intervention was required. Both operating tables could be utilized simultaneously with full anesthesia support. Postoperative patients were taken to the intensive care unit for further care and preparation for evacuation. Many soldiers sustained injury that precluded their return to duty. These patients were evacuated by helicopter or aircraft to higher echelons of care.

Shortly after the fall of Baghdad, it became apparent that the needs of the Iraqi medical community needed to be addressed urgently. Several members of the 212th MASH, in conjunction with the 30th Medical Brigade, were tasked to evaluate hospitals in Baghdad and assist in the delivery of donated medical supplies. These hospital assessments revealed basic infrastructural deficiencies and requirements for potable water, fuel for hospital generators and security to prevent looting. Hospitals in the Baghdad area adapted quickly to the crisis and were functional within days after the fall of the city.

## CONCLUSION

Since World War II, MASH units have provided immediate, lifesaving surgical care on the battlefield. The experiences of the surgeons and anesthesiologists assigned to these units have translated, in many instances, to important innovations in the delivery of civilian trauma care. The 212th MASH is the last MASH in the U.S. Army due to be decommissioned in the latter part of 2006. The 212th contributed greatly to the recent combat operations in Iraq and will undoubtedly become part of the lasting military and surgical legacy of the MASH. The lessons learned from MASH units during the last 60 years will, no doubt, form the basis for the design of future mobile military medical units.

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## About the Author

Booker King attended The Sophie Davis School of Biomedical Education at the City College of New York in 1987. This is a seven-year BS/MD program designed to increase the number of minorities in medicine. He completed clinical clerkships at New York University School of Medicine and received his medical degree from NYU. He completed his residency in general surgery at the State University of New York at Buffalo (1994–1999). During his surgical training, he was commissioned as captain in the U.S. Army reserves (1995). Upon completion of his residency, he was assigned to Moncreif Army Community Hospital at Fort Jackson, SC. He deployed to Bosnia-Herzegovina with the 28th Combat Support Hospital while assigned at Fort Jackson. In mid-2002, King was reassigned to the 212th Mobile Army Surgical Hospital (MASH) with duty at U.S. Army Hospital, Heidelberg, Germany. He deployed in support of Operation Iraqi Freedom from February to May 2003. He is currently chief of the general surgery section in Heidelberg.

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